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ABSTRACT

This document reports on a study which focused on improving the flexibility and responsiveness of vocational education and training provision in Great Britain by producing a plan for information technology-based open learning (ITOL) provision. In the first section, the ITOL model is described through three scenarios. Benefits to learners such as the removal of time, space, and learning barriers are summarized in the next section, and the third section offers background on open learning. Tne fourth section provides a diagram and detailed description of the model in terms of the various elements (learner, tutor, company counsellor, resources, and resource manager) and their interactions. Significant projects and resources external to the ITOL model are considered in the fifth section, including the Developing European Learning through Technological Advance project, the European Programme for Advanced Continuing Education program, and U.S. and British initiatives. The sixth section outlines outcomes and research needs in four areas: (1) electronic communications systems for open learning; (2) retrieval of learning resources; (3) online databases and document delivery; and (4) communications and computer networking. The seventh section analyzes ITOL system costs to the user and the institution. Six references and 95 additional sources on open learning and computer conferencing, information retrieval, and North American experiences are listed. (MES)

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Information Technology – based Open Learning – a Study report

Occasional Paper: InTER/12/89
July 1989

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Information Technology - based Open Learning

A Study into the feasibility of providing Electronically Mediated Open Learning

PREFACE

This Occasional Paper reports on a Study undertaken by a team at the University of Lancaster comprising representatives of Management Learning, Computer Science, Psychology and the Library. It was commissioned by the Learning Systems and Access Branch of the Training Agency.

The stated aim of the Study was:

> "to improve the flexibility and responsiveness of vocational education and training provision in Great Britain through producing a plan for the creation of information technology based open learning provision alongside established practices in existing universities."

This paper is an extract from the Final Report submitted to the Training Agency and we are grateful for their permission to make it generally available. In doing so the ESRC - InTER Programme hopes to stimulate discussion about the variety of ways in which the new technologies can benefit education and training and about the many human factors involved in this form of open learning.

The project team is grateful to the members of its Steering Group and to those in industry and in the University who discussed the concepts of ITOL during interviews.

Professor R. Lewis
ESRC - InTER Programme
University of Lancaster
June 1989

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1. INTRODUCTION

The specific objective of the Study was to develop a model of information technology based open learning (which came to be termed ITOL) which could be implemented. The model would define how desk - top computers, modern communications technology and on - line educational computing could be employed in the provision of up - to - date, relevant and supportive forms of open learning for people geographically distant from each other and from a university.

The model which evolved during the Study may be best understood in terms of a number of possible scenarios of the model in action. These scenarios are based on the use of existing technology and facilities. The anticipated advances in technology in the quite short - term, by the mid - 1990's, for example, the general availability of Integrated Services Digital Network (ISDN), would significantly enhance the educational effectivity and capability of ITOL.

1.1 Scenario A

Jean Sellers is a practicing accountant who is involved in advising banks on taxation issues. She has been studying the 1989 Finance Bill and thinking about how it will affect her work. There is an aspect of the Bill which she feels is not clear to her. She knows the Bill has been the subject of an ITOL computer conference in which she has been participating. Consequently, she sits down at her personal computer and calls up the ITOL system (via British Telecom PacketSwitch Stream) and logs into the ITOL mainframe computer. From the menu of ITOL directories instantly displayed on her screen, she chooses the Conference area, and joins the conference on the 1989 Finance Bill. The system automatically tells her that since she last participated in the conference, two or three people have been conducting an exchange about various aspects of the implementation of the Bill. She scans summaries of these discussions, and decides to download the full text for off - line perusal after the on - line session.

There is also a message from the resource manager to inform participants that some requested applications software which deals with the technical side of the issue she is concerned with is now available on the computer. She decides to quit the conference and access the application package.

This she does successfully and spends half an hour looking at the package and what it does. She then logs - out of the ITOL system, prints out the text of the computer conference and sits down with a cup of tea to reflect upon the dialogue of the conference, and how she could use the on - line application package to check out something which is still bothering her about the implementation of the Finance Bill.

Knowing she has an important meeting with her boss in fifteen minutes, she makes some comments on the word processor to add to the computer conference later on, notes her thoughts on the computer note pad on how to use the application package to solve the issue still bothering her, and leaves for the meeting.

Three hours later, Jean logs - into ITOL again and instructs her personal computer to add her previously typed comments to the computer conference. She then looks over her note pad comments on how to use the application package, calls up the

application package and inputs some data. Almost immediately the consequences of a key formula for her data appear on the screen (she prints this out on her own printer). Whilst this helps her to feel clearer about the formula itself, she realises the implications of the particular aspect of the Bill may be more far reaching than she originally suspected. She returns to the computer conference on the Bill, and adds some more thoughts on its implications, then sends her tutor a note asking for his thoughts on the matter and his ideas about what else on ITOL might be relevant for her to look at. She then logs off, and makes a note in her computer diary to return to the conference later in the week.

1.2 Scenario B

Ken Brown is Project Director of an engineering firm producing machines and equipment for the manufacturing industry. He is acutely aware of the extent the firm is loosing out to competitors generally, and foreign ones in particular. The problem is, his firm's machines don't have the sophisticated specifications or operational versatility that their competitors have. He has recently taken on two electronic engineers in order to extend his firm's design capability. But he is finding he doesn't speak the same professional language as the two engineers, and also he wonders if they appreciate the costs that would be involved in implementing some of their decisions.

None the less, Ken appreciates they will have to upgrade their machines, and he only wishes he had a better appreciation of what the electronic engineers were suggesting and the range of options and alternatives that exist.

Ken recalls receiving a recent circular information about an electronic learning and support network that Lancaster University has set up for engineers. He digs the circular out and reads that the intention of the network is to provide engineers with the access to people and resources that they require in order to deal with their own learning and development needs. The circular gives him both an electronic mail address and telephone contact number. Ken decides to ring, and is put through to someone who explains that if he wishes to join the network he will need the use of a PC workstation and a modem to connect to the telephone system. Also, that once he is registered he will be allocated a tutor from the University who he will be able to contact via electronic mail and who will help him and advise him about the system and the resources within it.

After receiving further details through the post, Ken decides to join the network and sends in the application form. Shortly afterwards he receives his password and number for accessing the system, together with a card detailing step by step what he needs to do to make his first contact with his tutor. He immediately sits down at his personal computer and follows through the steps outlined on the card. He manages to access the system and is immediately informed of an email message waiting for him. The message is from his tutor, and welcomes him to the system and asks him some questions about himself, why he joined the network and what kind of learning and development needs he has. Once he has read the message Ken sends a reply to his tutor explaining his situation and problem and then logs – out.

First thing next morning Ken accesses the system once more and sees that he has received a second message. Again, this is from his tutor who suggests that Ken

might find it useful to examine a training opportunities database in mechatronics which is on the system. Also, he explains there is a mechatronic design database which he could explore, but probably he might first find it useful to look at some of the case - study material that the network has generated. His tutor also advises him to join a mechatronics case - study conference which is on - going and which discusses many of the issues with which he is concerned.

Ken decides to call up the case - study material database and spends half an hour browsing through it, making notes in his computer note pad as he goes along. Already he feels he will be able to benefit from being part of the electronic network.

1.3 Scenario C

A group of learners using ITOL have been communicating for some time about the implications of new initiatives in the field of management development within organisations.

They decide that in order to further their own understanding of management development, and in order to help others who are new to the field and who might be looking towards the ITOL system for some form of support and help in this area, they should set up a database of information and resources about management learning. Each of them has considerable experience as practicing management developers, but none of them has the most up to date information about the field. They decide to share out the responsibilities of developing their ITOL learning resource in the following manner:

- Each member would in - put bibliographic references to the Management Development database, which would be set up by one of them as a computer conference on the ITOL system. It would be possible to search this in a variety of ways, and one of them would have the responsibility of maintaining a keyword reference to the conference, making this available as a separate topic in the conference listing.
- One of them would perform an online search of the American databases available via the ITOL gateway; someone else would carry out a similar search of British Library databases. The outcomes of these searches would be lodged in their own ITOL Management Development database for everyone's use.
- Another member would search the ITOL users database to select possible ITOL learners and tutors who might have something in common with their work and who might be invited to join their proceedings from time to time as 'expert' consultants. A new database of Management Developers would be set up and maintained by one of them.
- One of them had heard of a residential seminar on Management Development Strategies for Learning Companies offered by someone at Lancaster University. They decided to contact this person, and invite him to run a similar electronic seminar on ITOL for their group. If necessary, they would be able to offer a separate fee for this.
- A computer conference is established around the theme of New Strategies for Developing Managers. Each member would have the responsibility of running a topic in this seminar, which would be freely open to any ITOL

users. Amongst the first themes to be discussed in the electronic seminar are:

Post Modernism and Deconstruction
Biography Work
The Global Knowledge Society
Organisational Culture and Management Development
Gender Issues

- They send electronic invitations to all ITOL users to join their seminar and contribute to the databases. In addition, they ask the ITOL resource manager to send electronic invitations to international network users, informing them of their electronic forum and inviting them to submit documents, references and other information which might be of use to them. They also invite participation from the international community to the electronic seminar.

  Some weeks later the electronic seminar is well under way and thriving, with a lively debate on issues of Management Development. As well as UK ITOL participants, there is a small but growing international element, with people from Australia, California and Sweden regularly participating. The databases continue to expand, and several of the participants have begun to produce an electronic journal on Management Development which is freely available on ITOL, and sent to other networks for distribution.

2. BENEFITS TO LEARNERS

The ITOL model, as characterised in these scenarios, has developed with the needs of client learners in mind. From the perspective of the user of the system, there are certain benefits to be gained from taking advantage of this information technology-based ('on-line') form of open learning:

2.1 Time and space barriers are removed

A typical ITOL learner will be a person at professional and/or graduate level employment. Often, such people are hard pressed to take time off work to go on residential up-dating and professional development courses, which can often last between one to five days, and which usually require travelling to a distant site. ITOL would offer an alternative to this. Learners could take part in professional development activities without having to leave their work place. At the present time all that is needed is a desktop computer and modem linked to the public telephone system : this will link them to the on-line professional education system, ITOL. (Future ITOL users would access the system through a multi-media workstation). The flexibility of ITOL would permit them to learn at times and places convenient to themselves - ITOL would be there 24 hours a day, seven days a week all year round, without the need to travel to face-to-face meetings.

2.2 *Learning barriers are removed*

Residential courses are often also pitched at a wide spectrum of a known population, and a common criticism of them by participants is that they do not cater for their particular learning needs. The educational philosophy underpinning ITOL is one that works towards allowing the learner to define his or her own learning and personal development needs, with the ITOL system offering ways of reaching these self - defined needs. This is achieved through a process of negotiation, collaboration and cooperation between the ITOL learner, the ITOL tutor and the ITOL resources. So ITOL could help overcome the problems of participating in courses too general for a learner's specific needs and goals.

This is not to suggest that ITOL can be a panacea for all professional development needs. There will always be an important place for residential courses and the like; but ITOL can offer an alternative to what are often seen as restrictive methods of professional development provision. ITOL will not supplant existing professional development provision, rather, it will supplement and add to existing provision.

3. THE BACKGROUND TO OPEN LEARNING

Before going into more detail of the ITOL model, it is helpful to place this in the context of current perceptions of Open Learning.

From the inception of the project the team sought to develop an ITOL model which takes a different and hopefully innovative approach to distant, open education.

As T R Morrison points out in a recent paper on the potential impact of information technology in the role of higher education in society:

> "some distance educators have become so wedded to particular concepts of distance education, and the belief system that it engenders, that they have become the new traditionalists in an innovative field." (Morrison, 1989).

He goes on to say:

> "At this point in time distance education needs to be understood for what it is : a technique to overcome primarily, spatial barriers to learning. It is not, in its current stage of development, a process which overcomes cultural, economic and educational barriers to learning.
>
> If it is to fulfill this wider mission, distance education needs to recast conceptually within the broader and more normative concept of an open - learning system." (Morrison, op cit).

To claim that the team hoped, in developing a model of ITOL, to overcome cultural, economic and educational barriers to learning would not be wholly true. We were not, however, unmindful or unsympathetic to such views as Morrison's, and we did want the model to reflect an open learning educational philosophy. That is, we wanted it to be learner - centred, where learners not only have freedom of choice but also the opportunity and power to exercise that choice and to control and be responsible for their own learning development.

4. THE ITOL MODEL

In the research to develop a model of ITOL emphasis was placed upon:

- the suitability of available (and future) technology and the kind of resources it can give access to; and
- what, in practice, an ITOL type provision might look like in the areas chosen for the Study, viz. mechatronics, accountancy and finance, and management learning.

Out of this work has grown a model for ITOL which seems feasible and educationally viable and beneficial.

The outline of the ITOL Model is shown in Figure 1 and described in some detail later. Fundamentally, it allows any individual learner to communicate with a tutor or tutors, or facilitator(s) (most likely university based people, but not exclusively), with other learners and with a series or collection of both university and non-university based resources. In addition, learners may have available to them a counsellor from outside the university system, most likely someone from inside their own organisation. Finally, as depicted in Figure 1, there is a university based resource manager with whom learners can also communicate.

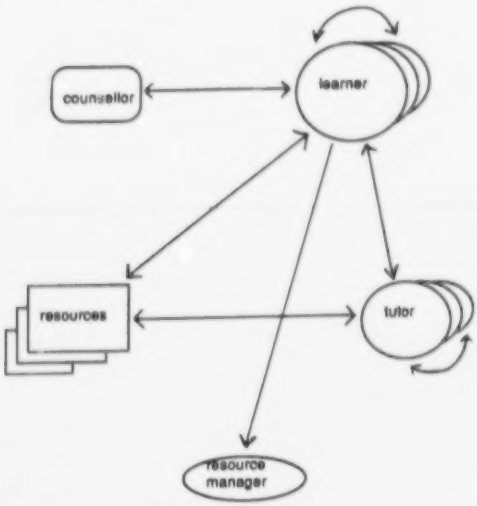

Figure 1: The ITOL Model

The Model can be simply described in terms of various actors and objects (as identified in Figure 1) and the interaction between them in terms of their needs and the contribution they make.

Learner

The learner is the person who wishes to use ITOL. The learner will typically be someone at professional and graduate level employment. They may wish to use ITOL for a variety of professional development reasons, eg. to tackle some new work related task; to further their own personal development; to enhance their career prospects and so on. The learner's needs may be defined by themselves, by the needs of their employing company or by some external source (eg. by the standards set by a professional body which the learner may be planning to join or whose external professional examination the learner is working towards).

The learner will need information about the purpose of the system, its scope (the degree to which it covers areas of concern in their work and professional development), how to access it via the telecommunications system, how to navigate through it once accessed (including details of information resources, communicating with tutors and other learners, requesting further information and delivery of resources, and so on). The learner will also need considerable support from the system itself, for example by way of on – line help advisers and software.

Each learner will require the use of a workstation to access and use the ITOL system. The basic requirements for a workstation are a stand alone personal computer with at best 1 Mbyte of internal memory and fixed hard disk storage capacity (eg. 20 Mbytes or higher); high resolution monitor; keyboard and mouse device; suitable text processing and communications software; printer and modem (the modem connected to the BT telephone system or some other computer network which would allow data access to ITOL). Several possibilities exist, including the *Thought Box* terminal being developed for the Training Agency at the Open University.

Tutor

Tutors will normally be academics or other subject specialists who will help learners with their learning. The tutor will not take on the traditional role of 'leading' the learner in an exploration of the subject matter; he or she will act as a resource to be called upon by the learner when necessary. The relationship between the learner and the tutor will be one of professional partnership and co – operation, not teacher and taught. The tutor will establish friendly contact with the learner and will help him or her think through their issues of concern and seek to establish a supportive relationship.

For example, tutors may help learners find their way through the various ITOL resource materials in order to help them resolve the problems or issues at hand; they may answer queries and questions concerning learners' work and professional development, and generally take part in on – going electronic discussions with learners; they may lead, or take part in, computer conferences (electronic seminars; tutorials; group discussions) dealing with whatever issues have emerged from the various discussions with individual learners. The purpose of this relationship will be to try and meet as many of the needs of the learner as possible, by a variety of methods and resources and establish a constructive learning and development relationship with learners.

In order to fulfill this role, tutors will require professional development in the use and purposes of ITOL. The role of an on – line (electronic) tutor has much in common with the more traditional, face – to – face tutoring activities. However, the ITOL medium will be new and strange to most tutors, and we cannot expect them

to see immediately how to transfer their normal professional activities to the medium without some form of briefing and training in the scope, purposes and uses of the system. Implicit in this will be a need to explore with them the nature of the 'open' educational philosophy underpinning the ITOL system.

It is likely that after any initial briefing and training, tutors will require on-going support in the educational uses of ITOL. This might best be achieved by perceiving the professional development of the tutors as a form of educational action research which is on-going and developmental, with spirals of learning activities emerging from considered and reflective analysis of their professional ITOL practice.

Each tutor will require the use of an 'ITOL' workstation, as described above for learners.

Company Counsellor
Learners may use ITOL for their own personal benefit, with no relationship to, or sponsorship by, an employing company. Self employed people may come into this category.

In situations where learners are participating in ITOL for company as well as personal benefits, the needs of the company will have to be taken into account.

Such learners will be sponsored by their company and will be working towards meeting needs of their company as much as their own. In situations like this, it would be advisable that a company counsellor will liaise with the learner and with those running ITOL. This counsellor will be in a supportive role to the learner, helping him or her in their quest for self and professional development.

The relationship between ITOL and the company will be important in these situations since the company will be a stakeholder in the learning enterprise. Such a relationship could take several forms, and be at several levels. For example, special resources could be made available on ITOL for particular company needs; groups of learners from one company, perhaps working on a particular problem or issue, could be accommodated by assigning them to one tutor with a specialist interest in that area of work; tutors could take on the role of consultant to learners in a company, working closely with the company in defining its needs and acting as a broker for putting the company in contact with resources and people of use to it; requests by the company for access to known tutors and resources not already available on ITOL could be considered.

The level at which this relationship may take place will vary from situation to situation. In some companies, it may be appropriate for senior management to be involved; in others, line managers may be involved; in some, it may be that the individual learner will be the person best suited to establishing this relationship (for example, the learner may be a senior manager). Some companies may wish to deal with ITOL via a training officer or manager.

No matter what the form or level of contact with a company, the overall purpose of the relationship between the company and ITOL would be to negotiate the needs of the company in relation to learners' needs and uses of ITOL, and work out strategies for ensuring that the ITOL system could help meet those needs.

Resources

The resources available on the ITOL system will be defined largely by the domains of application. These will include the following forms of resources:

- resources specially developed and made available by the institution(s) of higher education running ITOL. For example, on - line addresses and phone numbers of relevant specialists (tutors, etc); on - line addresses and phone numbers of people with similar needs and interests; references to useful textbooks, or sections thereof; references to recent review articles; details of existing and upcoming courses; access to relevant databases; access to electronic tutoring packages; access to electronically browsable texts; access to pictorial information and video sequences.

  Access to some of these is possible at the moment (eg. it is easy to access online databases, electronic tutoring packages and so forth). Access to others will be possible in the near future (eg video sequences will be accessible when digital telecom lines are available). Where learners cannot access the appropriate resource direct, it may be possible for them to request a copy (for loan or purchase) via ITOL which will be sent to them by conventional mail or fax.

- resources offered on - line by other institutions, and/or agencies which can be accessed via a gateway at the host ITOL institution. For example, the BLAISE (British Library) online system in London, and DIALOG in California could be accessed. Both of these provide access to a variety of databases in themselves.

- human resources in the form of on - line tutors and other ITOL learners. In addition to the various resource databases and gateways available to ITOL learners, there will be a sophisticated interactive electronic mail and computer conferencing system at the core of ITOL. This will facilitate communications between ITOL learners and tutors, allowing them to treat each other as a learning resource. The collective intelligence, knowledge and experience of ITOL users will be a natural and highly important organic learning resource.

- other resources not specifically made available by the ITOL host, but available elsewhere, might include video sequences (eg. tutored video instruction); tape slide sequences; audio tapes; computer software applications and so on. These would be made available through the post at the request of the learner.

Resource Manager

The resource manager is the person who mediates between those making decisions about the resources to be made available on the system, and actually putting them onto the system for learner access. This person maintains records of resources and updates and adds to them when necessary. He or she may also be responsible for a group of tutors in a particular domain, counting the tutors as key resources in addition to database and other learning resources.

In addition to the Resource Manager, a systems manager and technical adviser to learners and tutors is needed. The systems manager will oversee the whole ITOL, mainframe based system and it's effective and efficient running. The technical adviser will deal with problems and difficulties associated with accessing the system and using its various facilities. Technical advice may be given by a variety of methods, eg. by voice telephone or by electronic mail, depending on the nature of the query.

5. EXTERNAL ELEMENTS

The ITOL model builds upon various projects and resources which are external, that is not under the direct influence of the ITOL actors. The common factor in all of these is the role of IT within them. They are all, however, different in their aims and purposes and although they may have factors in common with ITOL (for example, the types of technologies employed or being developed), their underlying educational philosophies are quite different to ITOL. However, they all have features of potential interest and use for ITOL.

DELTA

The Developing European Learning through Technological Advance (DELTA) initiative aims to support the development of computer courseware, interactive video and network-supported courseware, plus the tools for using these resources. Similar to ITOL, at the heart of DELTA is the development of an IT-learner environment; in this case workstations for the home environment, the 'professional' environment and the 'specialist' environment. These would use distributed open systems (eg. ISDN and satellites) and appropriate hardware and software developed as part of the DELTA initiative itself.

The ITOL system is looking towards the development of DELTA and we would hope to integrate any of the DELTA specifications, standards and products whenever they become available. However, the present model of ITOL described in this document already proposes the use of several technologies and software systems which are being researched by DELTA Projects. For example, we propose the immediate use of email, conferencing, networks, file transfers, scanners, databases and fax for ITOL learners. We would look toward DELTA for advances in these facilities and development of others appropriate to ITOL. A recent paper from DG13 of the European Commission outlines a plan for a European Electronic University, a project called DEUCE. This has many features in common with the ITOL model developed in this Study but differs in at least one important respect; DEUCE is based on the provision of *courses* of the Open University type and is dependent on the development of suitable multi-media materials to be delivered through ISDN. Such course development will be a lengthy and costly task, and provides a much more structured form of learning, less adaptable to learners' needs, than ITOL.

PACE

The European Programme for Advanced Continuing Education (PACE) offers advanced technology training and updating in a variety of technological subjects, such as software engineering, expert systems, microelectronics and so on. These training courses are offered through European-wide video broadcasts by satellite (some 'live', others for recording at work sites for later viewing). Students are supported by email and computer conferencing and some audio-links to the live broadcasts (Longworth, 1988 & 1989; Frisk, 1988). PACE differs from ITOL in its underlying educational philosophy. The PACE system provides 'pre-packaged' courses mainly of 'tutored video instruction' format. The content of the PACE courses is decided in advance by subject experts; the aim is to provide skill and knowledge re-training and updating. ITOL, on the other hand, aims to provide a learning context in which learners' personal and professional development needs and requirements are the subject of exploration and negotiation.

USA Initiatives

Two major American initiatives indicate the possible future shape of distributed educational computing which may have important implications for the ITOL system. The *Athena* project at the Massachusetts Institute of technology and the *Andrew* project at Carnegie - Mellon University are long - term, multi - million dollar IT initiatives designed to develop and test all forms of technology in distributed systems. Suffice to say here that both projects are setting standards for the sort of learning environments which ITOL learners may eventually be using and the sort of networks they may be working over. These projects are showing that an educationally rich learning environment is possible via a distributed computing system and multi - media personal workstations.

British Initiatives

- Project *Granta* at Cambridge University is concerned with the development and application of distributed IT for academic teaching and research over the next 10 years or so. Four elements - mainframes, networks, distributed services and personal workstations - are being developed. Project *Granta* is financed by several sources to the tune of £4 million.
- Aston University's *Open Systems Interconnections (OSI)* demonstrator project *(ACCENT)* is aimed at promoting links between the University and local industry. It includes applications of distance learning, information and document delivery, email, teaching methods, communications technology and international communications. *ACCENT* has received funding from various sources eg. £1.2m from the UGC; £900K from the DTI, as well as substantial amounts from the University of Aston itself. The project aims to demonstrate and implement *OSI* within the context of higher education and professional continuing education, using two Ethernet channels over one hundred point - to - point links (with speeds of 19.2 kilobits to 2 megabits per second), eight one - way video channels and four two - way video channels. (*Educational Computing*, March 1989)
- At Bradford University, a campus - wide network is being installed and the problem referred to earlier of courseware development is being tackled by what is termed an "electronic learning - package factory", ELF (Stonier, 1985 and 1988).
- The University of London's *Live Net* system is an interactive video conferencing system linking nine of the London University Colleges. *Live Net* provides four full bandwidth TV channels each way and two megabits per second data capacity each way. It is seen as a test bed for ISDN developments.
- *Quartet* - a project funded by the British Library Research and Development Department - is focusing on integrated IT systems with a strong bearing on Information Services. The project's work on Automatic Document Delivery Services is of particular relevance to the ITOL system and the outcomes of this Project may well have features of possible use within ITOL.

It will also be possible, via the ITOL system, for learners to obtain information about some of these professional development initiatives. For example, ITOL could have details of the PACE courses and continuing education courses offered by higher education institutions.

6. OUTCOMES OF THE STUDY

As a result of the Study, it seems possible to identify four areas of concern on which future developments should focus.

6.1 *Electronic Communications Systems for Open Learning*

- Electronic communications systems will be at the core of ITOL learners' communications with the ITOL system.
- Computer supported co-operative work (CSCW) systems are modelled on 'real' group processes and exist to facilitate the work of geographically (usually) dispersed people working in structured situations.

  Computer mediated communications systems (CMCS) permit groups to 'impose' their own structure on their communications and 'design' their own learning environment. Electronic mail, conversations, bulletin boards and conferences form CMC systems.

  ITOL users would require a PC based workstation (PC, printer, modem) in order to use these systems (see 6.4 below for specifications). The CSCW/CMC systems would reside on the University mainframe computer.
- The role of CMCS in education is currently being researched. Current findings suggest that their use is acceptable to both students and tutors and that with careful and thoughtful design, they can support many learning activities conventionally associated with face to face meetings (and indeed offer opportunities beyond these).
- Within ITOL, CSCW/CMC systems will offer opportunities for learners and other users (tutors, etc) to communicate and learn together. In addition, they will offer a useful mechanism for the administration of the ITOL system itself.

6.2 *Retrieval of Learning Resources*

- It is not enough 'simply' to provide ITOL learners with convenient electronic access to all available information sources. The most useful resources must be carefully selected and indexed and entered into a resource catalogue; and the contents of this catalogue must be frequently reviewed and updated.
- If, as we anticipate, the ITOL resource catalogue is reasonably large, a highly organised searching system will be required, involving computer-based IR.
- IR tools must be available for use by untrained ITOL searchers, with prompt assistance given to users who get into difficulties.
- It would seem that no computer system corresponding to these requirements exists. However, a range of potentially useful IR software components certainly exists and some of these would probably be suitable for incorporation into an ITOL implementation.

6.3 *Online databases and document delivery*

- Access to appropriate public databases will have to be provided for ITOL users via ITOL institutions.
- Where costs are incurred in searching databases, restrictions may have to be imposed on (a) the amount of searching that can be done and (b) who does the searching (learner or someone else?)
- The ITOL institution (eg. University) library will be responsible for the delivery of all documents - initially by post or fax.
- As soon as they are available for use, document delivery systems should be incorporated into the ITOL environment (eg. the British Library Quartet Project delivery systems. Current work on this needs to be carefully monitored).

6.4 *Communications and Computer Networking*

- At present, the public switched telephone network (PSTN) provides a channel for data communications. Modems are needed for data communications since this is an analogue network. System X, a national digital network, is replacing this but will not be available until the early 1990s. This will provide a faster and cheaper method of data communication (but still requiring a modem if used from say one's home).
- Public computer (data) networks do exist at the moment, using packet switching techniques. JANET (the Joint Academic Network) links Universities and Colleges; British Telecom's Packet SwitchStream provides for the general public. Both systems use X.25 communication protocols.

  The advantages of these are the higher speeds affordable - typically 9600 bits per second to 56 kilobits.

  Open Systems Interconnection (OSI) is the standard architecture for data networks and will allow basically 'incompatible' hardware to be used in any communications.

  In the early stages of ITOL we would use all of the above. Users would link through the PSTN to the BT PSS (or JANET) network using a modem to connect their PC to the telephone system.
- At present, integrated digital access (IDA) is becoming available. This is a narrow band digital network, which will eventually be replaced by a broadband integrated services digital network (ISDN) in the mid 1990s. Both of these networks will be used in ITOL when they are available.
- ITOL users will require a workstation to connect to ITOL. In the early stages, this will probably take the form of a PC with 1 megabyte RAM, a hard disk storage capacity about 20 megabytes, a medium resolution screen with a window manager and a mouse pointing device; a printer and modem will also be required. (The Open University *Thought Box* student workstation may be suitable).

  Later in ITOL, a multimedia workstation will be required. This will be based on 32-bit processors, large (40 megabytes) disk storage, a bit-mapped, window-based display screen and a mouse. An internal phone, modem and fax machine may be incorporated along with the facility of video pictures capability.

The European DELTA Projects and the work at MIT (Athena Project) and Carnegie - Mellon University (Andrew Project) in the USA into the design and development of multi - media workstations will no doubt point the way forward. We already have details of, and have viewed, the American developments and will be continuing to monitor them. The DELTA projects have recently started and we have access to information about these and their outcomes which may be of use in an implementation phase of ITOL.

- Little research is currently being done in the field of computer supported co - operative work (CSCW) and multi - media systems. CSCW will be at the heart of ITOL and presently will be offered to ITOL users in the form of computer conferencing. However, several varieties of synchronous and asynchronous systems could be made available later. The Computer Science department at Lancaster University is currently researching and developing CSCW systems.

7. ITOL COSTS

So far this paper has focused on the benefits of an ITOL system and the technical advances necessary to make it effective. But what will it cost?

Rather than side - step this critical issue, an indicative analysis has been made of the major headings for a balance sheet and some approximations made of order-of-magnitude figures. Whilst the ITOL Model may last for years, these 'costings' will probably appear 'quaint' in only a few years time, maybe even before this paper is published!

1. Cost to the user

The approach taken has been to assess the external costs for a period of ITOL access of equivalent duration to a traditional course. In order to quantify this, it is estimated that a 3 - day residential course for professionals could cost £1500 inclusive.

Such a three - day course is assumed to contain 24 hours of tutoring and so ITOL access for 24 hours spread over 18 weeks has been costed. No assumptions can be made about relative effectivity beyond statements made earlier in the paper.

'Fixed' communication costs for a 24 hour period are:

i) local call charges (at standard use charges) for 24 hours over 18 week period:
   i.e. 24 x £3.90 (cost for 1 hour local call) = £ 93.60

ii) PSS account over 28 week period:
   £25 connection + £6.25 quarterly charge (x 2 over 18 week period) = £ 37.50

   Total BT costs = £131.10

Workstation costs are more difficult to assess but assuming the write - off of a PC over 4 years (ie. £5000/annum) and only one fifth PC use for ITOL, we arrive at £100 for the ITOL use of a workstation over one year.

This totals £230 for the 'course' and so leaves about £1250 for fees to tutors (8 hrs) and personnel use of ITOL resources (16 hrs) for the 24 hour period. Both tutors and resources (costed equally) could be paid for at £50/hour without exceeding the 'standard' £1500.

7.2 Costs to the ITOL Institution

These are even more difficult to judge as setting - up costs must be included, as should the 'hidden - costs' of an existing institution.

Taking an initial two year period for an institution setting up ITOL, the costs identified in the Final Report include:

- costs of developing and designing the ITOL databases and resources (including people costs). This would involve the costs of managing the system, a database specialist, communication engineer, librarian and pedagogist. In total, this would cost approximately £180,000.
- the costs of running and using the mainframe computer and associated software. This would involve the costs of computer staff services which would be approximately £30,000.
- the cost of the upkeep of the ITOL system. This would involve the costs of support staff (data entry, programming etc) which would be approximately £55,000.
- tutor and administrative costs. These would be about £100,000.

This is in total £365,000 and so around 250 "learner courses" would need to be run over 2 years to break even. In later years costs would be lower but certain other overheads would need to be included in long - term operation.

One should not omit to take account of institutional cost savings which might go some way to off - setting the usual overheads in universities currently calculated at about £20 per hour of academic staff time. These savings include:

- no buildings and associated running costs needed for ITOL courses;
- no residential course requirements and costs;
- tutors can use their time flexibly on ITOL and continue other activities at the same time.

8. POSTSCRIPT

The boundaries of electronic education for the professions are unknown. What evidence and research there is suggests that electronically mediated forms of higher and continuing education can be effective, worthwhile and acceptable to students and tutors alike.

However, the introduction of a scheme such as ITOL presents a new and totally unconventional answer to some of the problems of continuing professional education. It cannot be guaranteed that ITOL as an operational scheme will work, or that it will work in the ways implied in this paper. Most distance learning and information technology innovations tend to develop a life and existence of their own, somewhat different to the original intended aims. This is not necessarily a drawback and it would be a surprise if this did not occur in the ITOL system, given the flexible, liberal, open educational basis which is the starting point. However, the ITOL system should be sufficiently flexible in its educational focus to

allow client learner to mould it, use it and develop it in ways compatible with their needs and concerns.

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APPENDIX

The ITOL TEAM at the University of Lancaster

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Origins of the ESRC INFORMATION TECHNOLOGY AND EDUCATION PROGRAMME

The Education and Human Development Committee was established with the reorganisation of the then Social Science Research Council in May 1982. In 1984 the Council changed its name to the Economic and Social Research Council. Early in 1983 the Committee identified and circulated for discussion an initial listing of important topics which warranted expanded support or accelerated development. The broad area of Information Technology in Education occupied a prominent place in that list. The Committee emphasised its intention that research would be centred not only on the effect on education of machines to help teach the existing curriculum, but on the development and adaptation of the curriculum to equip people, including those of school age, to deal with intelligent machines and to prepare them for a life changed by their arrival. For example, there are questions concerning both cognitive and organisational factors which facilitate or inhibit the adoption of Information Technology in Education, and allied to these, questions around the nature, characteristics and development of information technology literacy. These initial topics remain central to the Committee's projected agenda.

Two reports were commissioned and detailed discussion and workshops were held in 1983. In its further considerations, the Committee was conscious of the fact that the research community is widely scattered and has relatively few large groups of researchers. Furthermore, it recognised the importance of involving practitioners and policy makers in the development of its programme of substantive research and research related activities and the necessity of ensuring close collaboration with commercial organisations such as publishers, software houses and hardware manufacturers. It was this thinking that led the Committee away from the establishment of a single new centre to the appointment of a coordinator as the focal point for the development of the initiative throughout the country.

The brief for the Coordinator included:

- the review, evaluation and dissemination of the recent and current activity in the field of Information Technology and Education;
- the identification of the needs of education in relation to Information Technology;
- the stimulation of relevant research and the formulation of research guidelines;
- the establishment and maintenance of a database of relevant work and undertaking arrangements for coordinating and networking of those active in the field including cognitive scientists, educational researchers, practitioners and policymakers.

In January 1988 the Council of ESRC approved a new initiative which would have resources to support a substantive research programme. This programme, the Information Technology in Education Research Programme, gets underway in the autumn of 1988. A new series of InTER Programme Occasional Papers will begin to appear in a similar format to the current ITE Programme series. The latter are listed on the back cover of this paper.

Papers currently available at no cost from:

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InTER/9a/89 A Guide to the Electronic Services, May 1989

InTER/10/89 Information Technology and Language Development – a seminar report, July 1989

InTER/11/89 Barriers to Innovation – a seminar report, July 1989

InTER/12/89 Information Technology – based Open Learning – a Study report, July 1989

InTER/13/89 Authoring Tools for simulation – based CBT – an interim project report, July 1989